Venomous snake occurrences across a continuum of protected and anthropogenic areas: a preliminary case study from Erode, southern India

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Abstract

Monitoring the status of wildlife such as venomous snakes that are medically important and thus directly relevant to public life has gained prominence over the years. We studied the patterns of venomous snake occurrences and incidences in a mosaic of protected and marginal habitats (in Vellode Bird Sanctuary) as well as humanized habitat (Erode Railway Colony), across a habitat disturbance gradient. Our study revealed the presence of three venomous snakes: spectacled cobra (*Naja naja*), Russell's viper (*Daboia russelii*) and common krait (*Bungarus caeruleus*) in all the three habitat zones. Based on 47 sightings obtained in toto over 120 days in the dry season, we found higher (40%) occurrences of venomous snakes in natural habitats (i.e. protected areas), followed by sightings (32%) in marginal (villages) and then humanized (township) habitats (28%) respectively. When analysed habitat-wise and species-wise, Chi-square test revealed statistically significant value (p-value =0.00971) only for the 'natural habitat' category. This short-term study indicates potential scope for furthering such surveys over larger, suitable areas as well as longer time frames.

Keywords: common krait, Erode district, man-snake conflict, protected area, Russell's viper, spectacled cobra, township, village

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Introduction

The ever-increasing human settlements and the consequent habitat destruction that ensue have been established as the greatest risk factor that endangers wildlife globally (Woodroffe et al., 2005; Treves & Santiago-Avila, 2020; Schell et al., 2021). Adding on to this, some animal groups are often pre-disposed to further anthropogenic disturbances due to their perceived risk to humans (Gowrishankar et al., 2013a,b; Longkumer et al., 2016). Venomous snakes are often considered, for bona fide reasons, as wild animals dangerous to human life (Gowrishankar et al., 2013a,b). On one hand, humans sharing lands with venomous snakes are highly likely to be subjected to retaliatory responses (bites) from the snakes, causing potential loss of human lives, if untreated (Suraweera et al., 2020). On the other, venomous snakes persisting in human-occupied areas suffer both indirect (habitat loss) and direct (wanton killing) anthropogenic threats (Sivakumar & Jadeja, 2012; Roshnath & Divakar, 2019).

Rescue and relocation of stray snakes from the precincts of human habitations have provided an amicable immediate solution to such man-snake conflicts (Urfi, 1999; Sivakumar & Jadeja, 2012; Vyas, 2013). These operations are primarily effected by Government-run Forest Department, sometimes aided by like-minded work force from other (private) sectors (Janani et al., 2015). However, paradigms are shifting and the protocols for rescue and relocation of snakes are being reviewed by field experts (Bonnet et al., 1998; Shine & Koenig, 2001). It is now being increasingly realised that total removal of habitat patches that act as refuges to such snakes living in marginal habitats will aggravate stray instances as the snakes search for alternatives (McKinney, 2006; Pragatheesh & Rajvanshi, 2013). Against such a backdrop it becomes important to monitor the status of venomous snakes in a mosaic of natural and anthropogenic areas. Here, we provide a preliminary case study from one such region having a small protected area persisting side by side with a humanised surrounding, in southern India.

Materials and Methods

Study Area

The study was carried out in the Erode District,northwestern part of the Tamil Nadu State, India. Two regions, one Protected Area along with its surroundings and one anthropogenic / township area that are reasonably close by (10 km apart) were chosen for the present study. The Protected Area (Vellode Bird Sanctuary; 11.253ºN 77.659ºE), hereafter VBS) and the anthropogenic / township area is Erode Railway Colony (11.324ºN 77.724ºE), hereafter ERC The studied sites, VBS and ERC are broadly situated under differing regimes of anthropogenic activities and pressures within Erode district (Radhika & Kavitha, 2020; Saravanan, 2007). VBS is a small (0.77 sq. km.) Protected Area that has a lake and grasslands with scrub vegetation, buffered with rural settings (Balasubramanian et al., 2015; Krishnamurthy et al., 2020). This district is characterised by low to undulating uplands and hills in northern parts, covered with thinly wooded scrub forests in the plains wherever it is not farmland / township, experiences warm to hot weather (25-38 °C), receives rainfall in northeast monsoon (September–December) (Krishnamurthy et al., 2020; Radhika & Kavitha, 2020; Saravanan, 2007).

Methodology

The study was done for a period of four months (February–May 2012). Primary field data was collected by two ways: (i) direct field observations by visual encounter method (Crump & Scott, 1994) as well as opportunistic sightings in VBS; (ii) accompanying the Forest Department staff during snake rescue operations in ERC. The term 'natural habitat' here refers to the natural climax vegetation type in VBS, consisting of grasslands, scrub and the lake, put together; the term 'marginal habitat' refers to the rural setting of villages present in around the VBS; the term 'humanised habitat' refers to heavily human-occupied town area,

the ERC. Venomous snakes sighted were identified using standard field guides (Whitaker & Captain, 2004). We focused only on venomous snakes and did not consider non-venomous snakes because in rural areas many of the local people were apparently aware of their harmless nature and were rather unperturbed or non-reactant if such a snake was near about their property (pers. obs. with instances of colubrid and natricid snakes). To eliminate this bias of people's response from the data set we focused only on venomous snakes in this work. Chi-square test was performed with a hypothetical, expected value of equal sighting frequency of venomous snakes of any species in any habitat category. Tests were performed using PAST software (Hammer et al., 2001).

Results

A total of 47 sightings comprising of three species of venomous snakes: spectacled cobra (*Naja naja*), Russell's viper (*Daboia russelii*) and common krait (*Bungarus caeruleus*) were recorded during the study. All the three species were recorded in both VBS (natural habitat, marginal habitat) and ERC (humanized habitat). The number of sightings (n=47) over the study period (120 days) amounts to an average of one venomous snake sighting for every 2 ½ days. The break-up of sighting frequencies of the three species of venomous snakes across the three habitat zones discerned, is presented in Table 1. Chi-square tests (Tables 2, 3) reveal that the sighting frequency distribution in 'natural habitat' (habitat-wise classification) is statistically significant, whereas there were no species-specific differences.

Table 1. Distribution of sighting frequencies of venomous snakes across natural (VBS) and anthropogenic habitats (ERC) in Erode, Tamil Nadu. Abbreviations aw: area-wise, sw: species-wise, –: calculations not applicable.

Venomous snake species	Natural Habitat	Marginal Habitat	Humanised Habitat	Total (sw)	% Sightings (sw)
Naja naja	10	9	7	26	55.3%
Daboia russelii	8	4	5	17	36.2%
Bungarus caeruleus	1	2	1	4	8.5%
Total (aw)	19	15	13	47	–
% Sightings (aw)	40%	32%	28%	–	–

Table 2. Chi-square test summary statistics for habitat-wise break-up of venomous snake sightings in Erode, southern India. Entry in bold denotes statistically significant value.

Chi-square test parameters	Natural Habitat (observed)	Marginal Habitat (observed)	Humanised Habitat (observed)	Hypothetical Mean: Habitat (expected)
N1(∑ observed)	19	15	13	5.22
N2 (∑ expected)	15.66	15.66	15.66	5.22
Degree of freedom	2	2	2	5.22
Chi-square value	9.2692	5.0087	4.0278	–
p value (same)	**0.00971**	0.08173	0.13347	–
Monte Carlo p	0.0314	0.0936	0.152	–

Table 3. Chi-square test summary statistics for species-wise break-up of venomous snake sightings in Erode, southern India.

Chi-square test parameters	Spectacled cobra (observed)	Russell's viper (observed)	Common krait (observed)	Hypothetical Mean: Species (expected)
N1(∑ observed)	26	17	4	5.22
N2 (∑ expected)	15.66	15.66	15.66	5.22
Degree of freedom	2	2	2	5.22
Chi-square value	7.7213	1.7749	8.8094	–
p value (same)	0.021054	0.4117	0.01222	–
Monte Carlo p	0.8318	0.5549	1	–

Chi-square tests conducted based on habitat-wise (Table 2) and species-wise (Table 3) break-up of sighting frequencies of venomous snakes in Erode region indicate differing scenarios. When analysed habitat-wise, the sighting frequency of venomous snakes in 'natural habitat' was statistically significant, compared to that of other two habitats, namely 'marginal habitat' and 'humanised habitat'. The p-value obtained for 'natural habitat' sightings was 0.00971, and was the only statistically significant value of all. When analysed species-wise, the sighting frequency did not show any statistically significant results for any of the three venomous snake species, viz. the spectacled cobras, the Russell's vipers and the common kraits.

As is expected, the number of venomous snake sightings was the highest (n=19, 40%) in the natural habitat (VBS), followed by sightings (n=15, 32%) in the marginal habitat (VBS), and then by the sightings (n=13, 28%) in the humanized habitat (ERC). Providing a species-wise break up for this total number (47), spectacled cobra (n=26, 55.3%) was the best represented species, followed by the Russell's viper (n=17, 36.2%) and then by the common krait (n=4, 8.5%). Spectacled cobra was sighted the most in the natural habitat (n=10), followed by marginal (n=9) and humanised (n=7) habitats. Russell's viper was sighted the most in the natural habitat (n=8), followed by the humanised habitat (n=5) and then the marginal habitat (n=4). Common krait was sighted the most in marginal habitat (n=2), followed by equal sightings in both the natural (n=1) and

humanised (n=1) habitats.

Discussion

Many recent studies in the northern India have recently worked on the snake incidences in urbanized areas (Urfi, 1999; Nath et al., 2011; Vyas, 2013; Shroff, 2016; Gayen et al., 2019; Ingle et al., 2019). Most such works focused on the dynamics of snake rescue instances of select city-scapes. In southern India, Janani et al. (2015) worked on the dynamics of snake rescue instances in Chennai city. But, data on such snake occurrences and associated dynamics across a habitat disturbance gradient, explicitly comparing a protected and an anthropogenic areas is wanting. In this work, an attempt was made to fill in this lacuna, by explicitly comparing venomous snake occurrences across three discrete yet proximate areas: natural habitat (VBS), marginal habitat (VBS) and humanized habitat (ERC).

Two other venomous snakes, one common and one rare species, viz. the saw-scaled viper (*Echis carinatus*) and the slender coral snake (*Calliophis melanurus*) respectively are known from the study area (Daniel, 2002; Das, 2002; Whitaker & Captain, 2004). But, these two species could not be detected in the present study. It is hypothesized that predominant diurnal surveys and the study being conducted in dry summer months might be the reason that these two species had remained undetected, especially, the commoner saw-scaled viper. Though small in size, consequently having lower detection probability and a misconception as a harmless species, saw-scaled vipers have previously been represented in snake-rescue data sets. Regarding the three species that were recorded, in keeping with literature (Whitaker & Captain, 2004) kraits were recorded in marginal habitats more compared to natural habitats, but it was surprising to note that Russell's vipers were recorded more frequently in humanized habitats than in other habitats, even surpassing in proportion of spectacled cobras. One possible reason for this could be the congregation of rodents near homesteads and the consequent stray of the vipers into these backyards.

Among herpetofauna living in human-dominated landscapes, the only group that are of broad relevance and concern to humans by and large, are mainly the venomous snakes (Purkayastha et al., 2011; Ingle et al., 2019). Though one creates awareness to people on snakes (Sivakumar & Jadeja, 2012; Roshnath & Divakar, 2019), it is the venomous snakes which are often subjected to threat perceptions by people (Gowrishankar et al., 2013b). Changing people's mindset on venomous snakes is tough. At the same time, one also has to acknowledge the high numbers of snakebites and deaths in India (Suraweera et al., 2020). To this end, our study on the dynamics of venomous snake occurrences in India, across a habitat disturbance gradient will go a long way in addressing the inherent intricacies associated with man-snake conflicts. For examples, shed skins or sloughs of snakes could easily be used as reliable, fool-proof proxy to score the presence of a snake in a region and can be exploited as a rather simple source of secondary evidence in conducting snake surveys. Deploying local man-power to (safely) collect snake sloughs and involving experts to scrutinize/deduce the species present can make a time-consuming and labuor-intensive task rather fast and simple.

Even apart from humanised areas, be it heavy or marginal, the importance of freshwater wetlands is far from fully-realised in India (Venkatesan, 2007). Small, wetland bird sanctuaries are a predominant feature in much of Tamil Nadu (Balasubramanian, 1992; Subramanya, 2005). Often the undisturbed or 'natural' habitats would be of artificial origin (Bhaskar & Venkatesan, 2015). While some non-focal faunal groups had been studied in bird sanctuaries (Guptha et al., 2011; Murugesan et al., 2013; Priyatharshini & Dhanalakshmi, 2016), data on snake occurrences are still required. It is hoped that this preliminary study that was conducted for a short term would stimulate and further interest on this much

needed and rarely-addressed topic.

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Conflicts of Interest

The authors declare that there is no conflicts of interest.

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